ED - II - Ariketak - 001

Boolesen algebra

$a+b=b+a$ $\quad$ $a+b+c=a+(b+c)$ $\quad$ $a\cdot(b+c)=a\cdot b+a\cdot c$

$a\cdot b=b\cdot a$ $\quad$ $a\cdot b\cdot c=(a\cdot b)\cdot c$ $\quad$ $a+(b\cdot c)=(a+b)\cdot(a+c)$

$a+a\cdot b=a$ $\quad$ $\overline{(a+b+c+\dots)}=\bar a\cdot\bar b\cdot\bar c\cdot\dots$

$a\cdot(a+b)=a$ $\quad$ $\overline{(a\cdot b\cdot c\cdots)}=\bar a+\bar b+\bar c+\dots$

$a\cdot b+\bar a\cdot c=(a+c)\cdot(\bar a+b)$ $\quad$ $(a+b)\cdot(\bar a+c)=a\cdot c+\bar a\cdot b$

$\bar a\cdot\bar b+a\cdot b=(\bar a+b)\cdot(a+\bar b)$ $\quad$ $(\bar a+\bar b)\cdot(a+b)=\bar a\cdot b+a\cdot\bar b$

$a+\bar a\cdot b=a+b$ $\quad$ $a\cdot(\bar a+b)=a\cdot b$

$\bar a+a\cdot b=\bar a+b$ $\quad$ $\bar a\cdot(a+b)=\bar a\cdot b$

$a\cdot b+a\cdot\bar b\cdot c=a\cdot b+a\cdot c$ $\quad$ $(a+b)\cdot(a+\bar b+c)=(a+b)\cdot(a+c)$

$a\cdot b+\bar a\cdot c+b\cdot c=a\cdot b+\bar a\cdot c$ $\quad$ $(a+b)\cdot(\bar a+c)\cdot(b+c)=(a+b)\cdot(\bar a+c)$

$a\cdot b+a\cdot\bar b=a$ $\quad$ $(a+b)\cdot(a+\bar b)=a$

$a\cdot b+a\cdot c=a\cdot(b+c)$ $\quad$ $(a+b)\cdot(a+c)=a+(b\cdot c)$

$f=(a\cdot 0)\cdot(b+b)+(b+\bar b)\cdot(a\, a)+(b+1)\cdot(c\, c)$ ✓

$f=(b+1)\, a\, \bar a+a+c\, c+b\cdot 0+c$ ✓

$f=\bar a\cdot b\cdot\bar c+b\cdot c\cdot(\bar c+1)+a\cdot b\cdot\bar c\,(a+\bar a)$ ✓

$f=a\cdot\bar b+a\cdot b\cdot c+a\cdot\bar b\, c+a\cdot b$ ✓

$f=a\cdot\bar b\cdot c+e+d\cdot(a\cdot\bar b\cdot c+e)$ ✓

$f=a\cdot\bar b\cdot\bar c+a\cdot\bar b\cdot\bar c\cdot d+a\cdot\bar b$ ✓

$f=c\cdot d\cdot(a+b+c)$ ✓

$f=(a+\bar c+c)\cdot\overline{(a+c)}\cdot(b\, c+a+\bar a)$ ✓

$f=c\cdot d+a\cdot c\cdot\bar d$ ✓

$f=\bar a\cdot\bar b\cdot c+a\cdot d+\bar b\cdot c\cdot\bar d$ ✓

EO - II - Activitat - Cri2

1) $f = (a \cdot a)\ (b+b) + (b+\bar{b}) \cdot (a \cdot a) + (b+1) \cdot (c\ \bar{c})$

$a \cdot (b+b) + 1 \cdot (a \cdot a) + b+1 \cdot a$

$\cancel{b+b} + a\ a + \cancel{b+0}$ $\boxed{f = a}$

$a +$

2) $f = \cancel{(b+1)}\ a\ \bar{a} + a + c \cdot c + \cancel{b \cdot 0} + c$

$a + c + c$ $\boxed{f = a + c}$

3) $f = \bar{a} \cdot b\ \bar{c} + b \cdot c\ (\bar{c}+1) + a \cdot b \cdot \bar{c} \cdot (a+a)$

$b(\bar{a} \cdot \bar{c} + c + a\ \bar{c}) \rightarrow \cancel{b(a\bar{c}+c)}$ $b\bar{c}\ \cancel{(\bar{a}+a)} + bc$

$b\bar{c} + bc \rightarrow b(\bar{c}+c)$ $\boxed{f = b}$

4) $f = a\ \bar{b} + a \cdot b \cdot c + a \cdot \bar{b} \cdot c + a\ b$

$a\bar{b}(1+1) + ab\ (1+c) \rightarrow \cancel{a(\bar{b}+bc)} \rightarrow a\bar{b} + ab \rightarrow a\ (\bar{b}+b)$

$\boxed{f = a}$

5) $f = (a \cdot \bar{b} \cdot c + e) + d \cdot (a\ \bar{b} \cdot c + e)$

$a\bar{b}\ c + e\ (d+1) \rightarrow a \cdot \bar{b}\ c + e$ $\boxed{f = a \cdot \bar{b} \cdot c + e}$

6) $f = a \cdot \bar{b}\ \bar{c} + a\bar{b} \cdot \bar{c} \cdot d + a \cdot \bar{b}$

$a\bar{b}\bar{c}\ \cancel{(1+d)} + a\bar{b} \rightarrow a\bar{b}\ \cancel{(\bar{c}+1)}$ $\boxed{f \cdot a\bar{b}}$

7) $f = c \cdot d \cdot (a + b + c)$

$cda + cdb + \cancel{cdc}\ cd \rightarrow cd\ \cancel{(a+b+1)} \rightarrow \boxed{f = cd}$

8) $f = (a \cdot \bar{c} + c)\ (\overline{a+c}) \cdot \cancel{(b\ c + a + \bar{c})}$

$(a \cdot \bar{c} + c) \cdot (\bar{a} \cdot \bar{c}) \rightarrow$

$(a \cdot \bar{c} + c)\ \bar{a}\ \bar{c} \rightarrow$

$a \cdot \bar{a} \cdot \bar{c} + c \cdot \bar{c} \cdot \bar{a}$ $\boxed{f = 0}$

9) $f = c \cdot d + a\ c\ \bar{d}$

$c\ (d + a\bar{d}) \rightarrow c(d+a)$ $\boxed{f = c \cdot (d+a)}$

10) $f = \bar{a} \cdot \bar{b} \cdot c + a\ d + \bar{b} \cdot c \cdot d$

$\bar{b}c(\bar{a}+\bar{d}) + ad \rightarrow$ $\bar{b}c(\overline{a\ d}) + ad$ $\boxed{f = ad + \bar{b}c}$

ED - II - Atividade - 003

11a) $f = \overline{\bar a + \bar b + \bar c + a \cdot b \cdot c}$

$a + b + c + \cancel{\bar a + \bar b + \bar c}$ $\quad \boxed{f = \overline{a \cdot b \cdot c}}$

11b) $f = \overline{(\bar a \cdot c) + (\bar b \cdot \bar d) + a + c}$

$\cancel{a + \bar c \cdot b + d \cdot \bar a \cdot \bar d}$ $\quad \overline{(\bar a\ c)} \cdot \overline{(\bar b\ \bar d)} \cdot \bar a \cdot \bar c$

$(a + \bar c) \cdot (b + d) \cdot \bar a\ \bar c \rightarrow \bar a \cdot \bar c\ (a + \bar c) \cdot (b + d) \rightarrow (\cancel{\bar a \bar c a} + \bar a \bar c\ \bar c)(b + d)$

$\boxed{f = \bar a \bar c \cdot (b + d)} = \overline{(a + c)} \cdot (b + d) = \overline{(a + c) + \overline{(b + d)}}$

12) $f = \overline{[\bar a \cdot \bar c + (b + c)]} \cdot d$

$\overline{[\bar a \cdot \bar c + (b + c)]} + \bar d \rightarrow \overline{(\bar a\ \bar c)} \cdot \overline{(b + \bar c)} + \bar d \rightarrow (a + c) \cdot (\bar b \cdot c) + \bar d$

$\overline{[\bar a\ \bar c + b + \bar c]} \cdot d \rightarrow \overline{[\bar c + b]} \cdot d \rightarrow \boxed{f = c \cdot \bar b + \bar d}$

$\overline{[\bar c\ (a + 1) + b]} \cdot d \quad \overline{(\bar c + b)} + \bar d$

13) $f = \overline{a \cdot \bar b\ c + a\ \bar c + b}$

$\overline{a(\bar b c + \bar c) + b} \rightarrow \overline{a(\bar c + \bar b) + b} \rightarrow \overline{a \bar c + a \bar b + b} \rightarrow \overline{a \bar c + a + b}$

$\overline{a(\bar c + 1) + b} \quad \overline{a + b} \quad \boxed{f = \overline{a + b}}$

14) $f = a + b + c + d$

$f = \overline{(\bar x \cdot \bar y \cdot \bar z + \bar x \cdot y \cdot z + x \cdot \bar y \cdot z + x \cdot y \cdot \bar z)}$

$f = \overline{(x + y + z)} \cdot \overline{(\bar x + y + z)} \cdot \overline{(x \bar y z)} \cdot \overline{(x y \bar z)}$

$f = (\bar x + \bar y + \bar z) \cdot (x + \bar y + \bar z) \cdot (\bar x + y + \bar z) \cdot (\bar x + \bar y + z)$

$[\bar z + (x + \bar y)] \cdot [\bar z + (\bar x + y)]$

$\bar z + [(x + \bar y) \cdot (\bar x + y)]$

$[(\bar x + \bar y) + \bar z] \cdot [(\bar x y) + z]$

$(\bar x + \bar y)\ [\bar z + (x + \bar y) \cdot (\bar x + y)]$

$(\bar x + \bar y)\ [\bar z + \cancel{x \bar x} + x y + \bar y \bar x + \cancel{\bar y y}] \rightarrow (\bar x + \bar y)(\bar z + x y + \bar y \bar x)$

$\rightarrow \bar x \bar z + \cancel{\bar x x y} + \bar x y x + \bar y \bar z + \bar x y \bar y + \bar y \bar x$

$\bar x \bar z + \bar x y + \bar y \bar z + \bar y x$

$\bar z(\bar x + \bar y) + \bar x \cdot y + \bar y x$

$\overline{(\bar x + \bar y)} + \overline{(\bar y + \bar x)}$

$\overline{(x + \bar y)(y + \bar x)}$

$\overline{y(x + \bar y) + \bar x(x + y)}$

$\overline{y x + \bar x \bar y}$

$\overline{y x} \cdot \overline{\bar x \bar y}$

$(\bar y + \bar x)(x + y)$

$x(\bar y + \bar x) + y(y + \bar x)$

$x \bar y + y \bar x$

ED - II - [illegible] - 2004

14) a) $f = (a+c)\cdot(\bar a + b)\cdot(b+\bar c + d)$

$(a\cdot b + \bar a\cdot c)\cdot(b+\bar c+d)$

$abb + ab\bar c + abd + \bar a cb + \cancel{\bar a c\bar c} + \bar a c d$

$ab + ab\bar c + abd + \bar a cb + \bar a cd$

$ab(1+\bar c+d) + \bar a c(b+d)$

$ab + \bar a cb + \bar a c d$

$b(a + \bar a c) + \bar a c d$

$\cancel{b(a+c) + \bar a c d}$

$\cancel{\bar a c}(b+d)$

$\boxed{f = b(a+c) + \bar a c d}$

15) b) $f = \overline{\bar a\cdot e + \bar b\,\bar d} + a + c$

$\cancel{a + (\overline{c+b}\;\bar d + \overline{a+c})}$

$\cancel{a + (\overline{c+b}) + (\bar d + \overline{a+c})}$

$\cancel{a + \bar c\cdot b + d\cdot(\overline{a+c})}$

$\cancel{a + \bar c\cdot b + d\;\bar a\cdot\bar c}$

$\cancel{\bar c(b + d\bar a) + a + d}$

$\cancel{\bar c\cdot[b\cdot(\bar d\cdot\bar a)] + a + d}$

$\cancel{\bar c\cdot[b\cdot(\bar d + a)]}$

$\cancel{\bar c b(d+a) + a + d}$

$\cancel{f = a + d}$

$f = a c + \bar a\cdot b + b\bar c$

$(a+b)\cdot(\bar a + c) + b\bar c$

$\cancel{a\bar a} + ac + b\bar a + bc + b\bar c$

$ac + b(\bar a + c + \bar c)$

$f = ac + b$

16) $f = a\cdot\bar c + a\cdot b\cdot\bar c + a\cdot\bar c\cdot d + a\cdot c\cdot\bar e + a\cdot\bar c\cdot f$

$a\bar c(\cancel{1+b+d+f}) + ac\bar e \rightarrow a(\bar c + c\bar e) \rightarrow a(\bar c + \bar e)$

$f(A,B,C,D) = \Sigma(0,1,2,3,13,15)$

A	B	C	D	F	
0	0	0	0	1	(0)
0	0	0	1	1	(1)
0	0	1	0	1	(2)
0	0	1	1	1	(3)
0	1	0	0	0	(4)
0	1	0	1	0	(5)
0	1	1	0	0	(6)
0	1	1	1	0	(7)
1	0	0	0	0	(8)
1	0	0	1	0	(9)
1	0	1	0	0	(10)
1	0	1	1	0	(11)
1	1	0	0	0	(12)
1	1	0	1	1	(13)
1	1	1	0	0	(14)
1	1	1	1	1	(15)

$(\bar A\cdot\bar B\,\bar C\,\bar D) + (\bar A\cdot\bar B\cdot\bar C\cdot D) + (\bar A\cdot\bar B\cdot C\,\bar D) + (\bar A\,\bar B\;C\;D) + (AB\bar C D) + (ABCD)$

$\bar A\bar B(\bar C\bar D + \bar C D + C\bar D + CD) + AB(\bar C D + CD)$

$\downarrow \quad \downarrow \quad \downarrow$

$\bar C(D+\bar D) \quad C(\bar D + D) \quad D(\bar C + C)$

$\downarrow \quad \downarrow \quad \downarrow$

$\bar C \quad C \quad D$

$\bar A\bar B + ABD$

$f(A,B,C) = \sum(2,3,4,5)$

A	B	C	F	
0	0	0	0	(0)
0	0	1	0	(1)
0	1	0	1	(2)
0	1	1	1	(3)
1	0	0	1	(4)
1	0	1	1	(5)
1	1	0	0	(6)
1	1	1	0	(7)

$(\bar A B \bar C) + (\bar A B C) + (A \bar B \bar C) + (A \bar B C)$

$\bar A B(\cancel{\bar C + C}) + A(\bar B \bar C + \bar B C)$

$\bar A B + A \bar B + \bar B(\cancel{\bar C + C})$

De Morgan-en adibideak

$\overline{x\,y\,z} = \bar x + \bar y + \bar z$

$\overline{x+y+z} = \bar x\,\bar y\,\bar z$

$\overline{\bar x + \bar y + \bar z} = x\cdot y\cdot z$

$\overline{(A+B+C)\,D} = \overline{(A+B+C)} + \bar D = \bar A\cdot\bar B\,\bar C + \bar D$

$\overline{ABC + DEF} = \overline{ABC}\cdot\overline{DEF} = (\bar A+\bar B+\bar C)\cdot(\bar D\,\bar E\,\bar F)$

$\overline{A\cdot\bar B + \bar C\cdot D + E\cdot F} = \overline{A\bar B}\cdot\overline{\bar C D}\cdot\overline{EF} = (\bar A+B)\cdot(C+\bar D)\cdot(\bar E+\bar F)$

$\overline{\overline{ABC} + D + E} = \overline{\overline{ABC}}\cdot\bar D\,\bar E = ABC\bar D\bar E$

$\overline{\overline{(A+B)} + \bar C} = (A+B)\cdot C$

$\overline{(\bar A+B) + CD} = \overline{(\bar A+B)}\cdot\overline{CD} = A\cdot\bar B\cdot(\bar C+\bar D)$

$\overline{(A+B)\cdot\bar C\,\bar D + E + \bar F} = \overline{(A+B)} + C + D\cdot\bar E\cdot F = (\bar A\cdot\bar B + C + D)\cdot\bar E\cdot F$

$\overline{\overline{ABC} + \overline{(\bar D+E)}} = ABC\cdot(\bar D+E) = ABC\cdot D\cdot\bar E$

$\overline{(A+B)\cdot C} = \overline{(A+B)} + C = (\bar A+\bar B)+C$

$\overline{A+B+C} + \overline{\bar D\cdot E} = (A+B+C)\cdot(\bar D\cdot E) = \bar A\cdot\bar B\cdot\bar C\cdot\bar D\cdot E$

ED - II · Activitat - ...

Funcions simplificades → canònica

(1) $A\bar{B}C + \bar{A}\bar{B} + AB\bar{C}D$

$A\bar{B}CD + \cancel{A\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}D} + \bar{A}\bar{B}\bar{C}\bar{D} \cancel{+ \bar{A}\bar{B}C\bar{D} + AB\bar{C}D}$

$A\bar{B}CD + A\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + AB\bar{C}D$

1011 1010 0011 0001 0000 0010 1101

$A\bar{B}C(D+\bar{D}) + \bar{A}\bar{B}(C+\bar{C})(D+\bar{D}) + AB\bar{C}D$

(2) $A + A\bar{B} + B\bar{C}$

$ABC + A\bar{B}C + AB\bar{C} + A\bar{B}\bar{C} + \cancel{A\bar{B}C} + \cancel{A\bar{B}\bar{C}} + \cancel{AB\bar{C}} + \bar{A}B\bar{C}$

111 101 110 100 101 100 110 010

$ABC + A\bar{B}C + AB\bar{C} + A\bar{B}\bar{C} + \bar{A}B\bar{C}$

(3) $(A+B)\cdot(A+\bar{B}+\bar{C})$

$(A+B+\bar{C}\cdot C)$

$A+B+C$ [illegible]

0 0 1   0 0 0   0 1 1

(4) $(A+\bar{B}+C)(\bar{B}+C+\bar{D})\cdot(A+\bar{B}+\bar{C}+D)$

$(A+\bar{B}+C+D)(A+\bar{B}+C+\bar{D})\cdot\cancel{(A+\bar{B}+C+\bar{D})}(\bar{A}+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+D)$

0 1 0 0 | 0 1 0 1 | 0 1 0 1 | 1 1 0 1 | 0 1 1 0

$(A+\bar{B}+C+D)(A+\bar{B}+C+\bar{D})(\bar{A}+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+D)$

Funcions simplificades

a) $A\cdot B + A(B+C) + B(B+C)$

$AB + AB + AC + B + BC$

$B(A+1+C) + AC \longrightarrow \boxed{AC+B}$

b) $A\bar{B} + A\cdot\overline{(B+C)} + B\overline{(B+C)}$

$A\bar{B} + A\bar{B}\bar{C} + \cancel{B\bar{B}\bar{C}}$

$\boxed{A\bar{B}}$

c) $[A\cdot\bar{B}(C+BD) + \bar{A}\cdot\bar{B}]\cdot C$

$(A\bar{B}C + \bar{A}\cdot\bar{B})C$ $\boxed{\bar{B}C}$

$A\bar{B}C + \bar{A}\bar{B}C$ $\bar{B}C(A+\bar{A})$

(d) $\bar{A}BC + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + A\bar{B}C + ABC$

$\bar{B}\bar{C}(A+\bar{A}) + BC(A+\bar{A}) + A\bar{B}C$

$\bar{B}\bar{C} + BC + A\bar{B}C$ $BC + \bar{B}(\bar{C}+AC)$

$BC + \bar{B}(\bar{C}+A)$ $BC + \bar{B}\bar{C} + \bar{B}A$

(e) $\overline{AB + AC} + \bar{A}\bar{B}C$

$\overline{AB}\cdot\overline{AC} + \bar{A}\bar{B}C$

$(\bar{A}+\bar{B})\cdot(\bar{A}+\bar{C}) + \bar{A}\bar{B}C$ $\boxed{\bar{A}+\bar{B}\bar{C}}$

$\bar{A}+\bar{A}\bar{C}+\bar{B}\bar{A}+\bar{B}\bar{C}+\bar{A}\bar{B}C$

$\bar{A}(1+\bar{C}+\bar{B}+\bar{B}C)+\bar{B}\bar{C}$

ED-II-[illegible]-COY

1) $f(A,B,C,D) = \sum(0,1,2,3,13,15)$

A	B	C	D	F	
0	0	0	0	1	(0)
0	0	0	1	1	(1)
0	0	1	0	1	(2)
0	0	1	1	1	(3)
0	1	0	0	0	(4)
0	1	0	1	0	(5)
0	1	1	0	0	(6)
0	1	1	1	0	(7)
1	0	0	0	0	(8)
1	0	0	1	0	(9)
1	0	1	0	0	(10)
1	0	1	1	0	(11)
1	1	0	0	0	(12)
1	1	0	1	1	(13)
1	1	1	0	0	(14)
1	1	1	1	1	(15)

$\bar A\bar B\bar C\bar D + \bar A\bar B\bar C D + \bar A\bar B C\bar D + \bar A\bar B CD + AB\bar C D + ABCD$

$\bar A\bar B\bar C(\cancel{\bar D + D}) + \bar A\bar B C(\cancel{\bar D + D}) + ABD(\cancel{\bar C + C})$

$\bar A\bar B(\cancel{\bar C + C}) + ABD$ $\boxed{\bar A\bar B + ABD}$

[illegible]:

$(A+B)\cdot(C+\bar B)$

$(A+B+C)\cdot(A+B+\bar C)\,(A+C+\bar B)\cdot(\bar A+C+\bar B)$

0 0 0   0 0 1   0 1 0   1 1 0

A	B	C	F	
0	0	0	0	(0)
0	0	1	0	(1)
0	1	0	0	(2)
0	1	1	1	(3)
1	0	0	1	(4)
1	0	1	1	(5)
1	1	0	0	(6)
1	1	1	1	(7)

$(A+B\cdot\bar C)\cdot C$ minterm [illegible]

$(AB+A\bar C)\,C$ $ABC + \cancel{A\bar C C}$ ABC

2)

A	B	C	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

d) $\overline{\bar A B\cdot(C+\bar D)+E} = \overline{\bar A B} + \overline{(C+\bar D)}\cdot\bar E$

$(A+\bar B) + (\bar C D)\cdot\bar E = A+\bar B+\bar C D\bar E$

e) $w+x+y+t$

$\left[\bar A B\cdot(C+\overline{BD})+\overline{AB}\right]\cdot CD \rightarrow (\bar A BC + \bar A B\overline{BD} + \overline{AB})\cdot CD \rightarrow \left[\bar A BC + \bar A B(\bar B+\bar D) + (\bar A+\bar B)\right]CD$

$\left[\bar A BC + \cancel{\bar A B\bar B} + \bar A B\bar D + \bar A + \bar B\right]CD \rightarrow \bar A BCD + \cancel{\bar A BCD\bar D} + \bar A CD + \bar B CD$

ED - II - Actividad - 008

0	0	1
1	0	1
0	1	1
1	1	1

e) $\left[AB(C+\overline{BD})+\overline{AB}\right]CD \to \left[AB(C+\bar B+\bar D)+\bar A+\bar B\right]CD$

$(ABC+AB\bar B+AB\bar D+\bar A+\bar B)CD \to ABCCD+\cancel{AB\bar B CD}+\bar A CD+\bar B CD \to ABCD+\bar A CD+\bar B CD$

$CD(AB+\bar A+\bar B) \to CD$

f) $AB\bar C+\bar A BC+\bar A\bar B C+\bar A\bar B\bar C \to AB\bar C+\bar A(BC+\bar B C+\bar B\bar C) \to AB\bar C+\bar A[C(B+\bar B)+\bar B\bar C]$

$AB\bar C+\bar A C+\bar A\bar B\bar C \to AB\bar C+\bar A(C+\bar C\bar B) \to AB\bar C+\bar A C+\bar A\bar B \to$

$(C+\bar B)$

g) $A\bar B C\cdot(BD+CD\bar E)+A\bar C$ | $A(\bar B CD\bar E+\bar C)$

$\cancel{A\bar B CBD}+A\bar B CD\bar E+A\bar C$

h) $w\bar x y+\bar x y\bar z+w\bar x\bar y$

$w\bar x yz+w\bar x y\bar z+w\bar x y\bar z+\bar w\bar x y\bar z+w\bar x\bar y z+w\bar x\bar y\bar z$

1011 1010 1010 0010 1001 1000

i)

$\bar x yz+\bar x y\bar z+x\bar y z+xyz+xy\bar z+x\bar y\bar z$

011 010 101 111 110 100

j) $ABCD+AB\bar C D+ABC\bar D+AB\bar C\bar D+\bar A BCD+\bar A B\bar C D+\bar A BC\bar D+\bar A\bar B C\bar D$

1111 1101 1110 1100 0111 0101 0110 0010

k) $AB\bar C+\bar A\bar B C+\bar A BC+\bar A B\bar C$

$B(\bar A C+\bar A\bar C)+B(A\bar C+\bar A C)$

$B[\bar A(C+\bar C)]+BA\bar C+B\bar A C$

$B\bar A+BA\bar C+B\bar A C$	$B(\bar A+A\bar C)$	$B(\overline{AC})$
$B\bar A(1+C)+BA\bar C$	$B\bar A+B\bar C$	
$B\bar A+BA\bar C$	$B(\bar A+\bar C)$	

$(A+B\bar C)C$ minterm

$AC+B\bar C C$

$ACB+AC\bar B$

$ABC+A\bar B C$

111 101

A	B	C	F	
0	0	0	0	(m0)
0	0	1	0	(m1)
0	1	0	0	(m2)
0	1	1	0	(m3)
1	0	0	0	(m4)
1	0	1	1	(m5)
1	1	0	0	(m6)
1	1	1	1	(m7)

$\sum(5,7)$

ED - II · [illegible] - 009

$(A+C)(AB+AC)$

$AAB + AAC + ABC + ACC$

$AB + AC + ABC + \cancel{AC}$

$ABC + AB\bar{C} + \cancel{ABC} + A\bar{B}C + \cancel{ABC}$

111 110 101

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$\sum(5,6,7)$

$(A+B)(C+\bar{B})$

$AC + A\bar{B} + BC + \cancel{B\bar{B}}$

$ABC + A\bar{B}C + \cancel{A\bar{B}C} + A\bar{B}\bar{C} + \cancel{ABC} + \bar{A}BC$

111 101 100 011

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

$\sum(7,5,4,3)$

$A\bar{B}C + \bar{A}\bar{B} + AB\bar{C}D$

1010 0000 1101
1011 0001
0010
0011

A	B	C	D	F	
0	0	0	0	1	(0)
0	0	0	1	1	(1)
0	0	1	0	1	(2)
0	0	1	1	1	(3)
0	1	0	0	0	(4)
0	1	0	1	0	(5)
0	1	1	0	0	(6)
0	1	1	1	0	(7)
1	0	0	0	0	(8)
1	0	0	1	0	(9)
1	0	1	0	1	(10)
1	0	1	1	1	(11)
1	1	0	0	0	(12)
1	1	0	1	1	(13)
1	1	1	0	0	(14)
1	1	1	1	0	(15)

$\sum(0,1,2,3,10,11,13)$

$A + A\bar{B} + B\bar{C}$

100 100 010
101 101 110
110
111

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

$\sum(2,4,5,6,7)$

$(A+\bar{B})\cdot(B+C)$

010 000
011 100

A	B	C	f
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$\prod(0,2,3,4)$

$(A+B)(A+\bar{B}+\bar{C})$ $\prod(0,1,3)$

000 011
001

$(A+\bar{B}+C)\cdot(\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+D)$

0100 0101 0110
0101 1101

$\prod(4,5,6,13)$

$(A+\bar{B}+C)\cdot(A+B+\bar{C})$ $\prod(1,2)$

010 001

$A\ (A+\bar{C})\cdot(A+B)$

$\prod(0,1,2,3)$

000 ~~001~~ 000
001 ~~011~~ ~~001~~
010
011

$(A+B)(C+\bar{B})$ 1,5,6,7

[illegible] 001
101

$AC + A\bar{B} + \cancel{B\bar{B}} + BC$ $\sum 3,4,5,7$

~~101~~ 100 011
~~111~~ 101 111

ED-II-Ankerl-010

$\bar{A}BC + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} + A\bar{B}C + ABC$

$\bar{B}\bar{C}(A+\bar{A}) + BC(A+\bar{A}) + A\bar{B}C$

$\quad\;\; = 1 \qquad\qquad\quad = 1$

$\bar{B}\bar{C} + BC + A\bar{B}C$

$C(B + A\bar{B}) \to CB + CA$

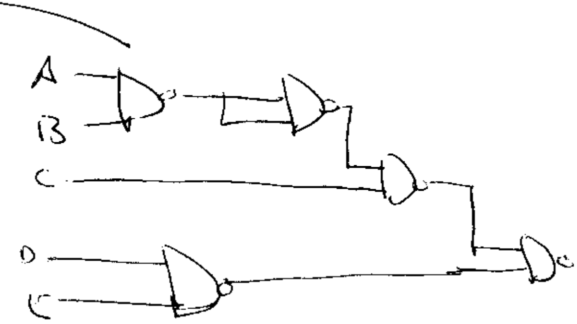
$\boxed{\bar{B}\bar{C} + AC + BC}$

$\overline{\overline{\bar{A} + B}}$

$\overline{A\bar{B}}$

Funktion 2 NANDe[illegible]

a) $\overline{\overline{ABC + DE}} = \overline{\overline{ABC} \cdot \overline{DE}} = \overline{\overline{ABC}\;\;\overline{DE}}$

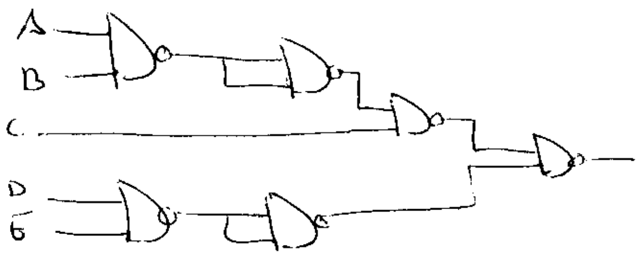


b) $\overline{\overline{ABC + \bar{D} + \bar{E}}}$

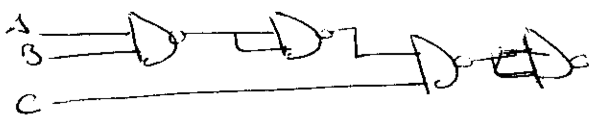
$\overline{\overline{ABC + (\bar{D} + \bar{E})}} = \overline{\overline{ABC} \cdot \overline{(\bar{D}+\bar{E})}}$

$\overline{\overline{ABC} \cdot \overline{(\bar{D}+\bar{E})}} = \overline{\overline{ABC} \cdot \overline{DE}}$

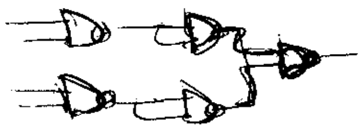
$ABC + \bar{D} + \bar{E} = ABC + \overline{DE} = \overline{\overline{ABC} \cdot \overline{\overline{DE}}} = \overline{\overline{ABC}\;\;\overline{\overline{DE}}}$



c) $ABC = \overline{\overline{ABC}}$



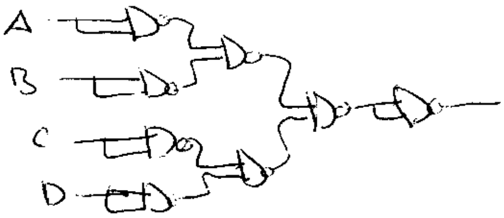
d) $\overline{\overline{AB + CD}} = \overline{\overline{AB} \cdot \overline{CD}} = \overline{\overline{AB}\;\;\overline{CD}}$



e) $(\bar{A} + \bar{B}) \cdot (C + D) = \overline{AB}\;\;\overline{\bar{C}\bar{D}}$

$\overline{\overline{\overline{AB}\;\overline{\bar{C}\bar{D}}}}$ $\qquad \overline{\overline{(\overline{AB})(\overline{\bar{C}\bar{D}})}}$

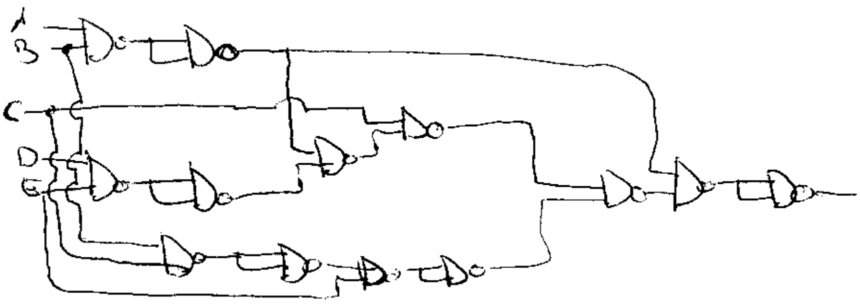
$\overline{\overline{\overline{AB}\;\overline{\bar{C}\bar{D}}}}$



f) $AB\left[C(\overline{DE} + \overline{AB}) + BC\bar{E}\right]$

$\overline{\overline{AB}} \quad C \cdot \overline{\overline{DE}\;\overline{AB}} \cdot \overline{\overline{BC\bar{E}}}$

$\overline{\overline{BC}\;E}$

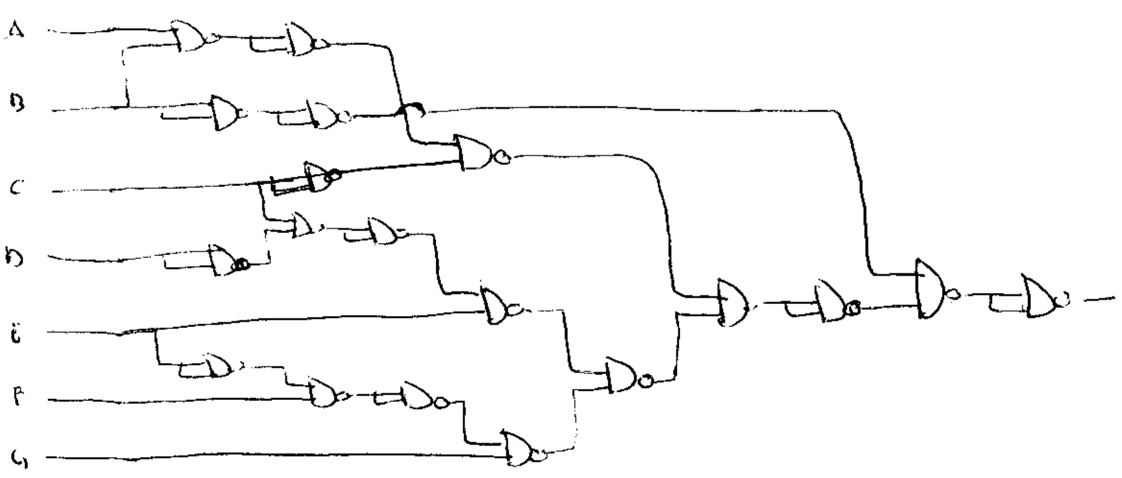


ED-II-Arkatek-011

$\overline{AC} \cdot \bar{A}\bar{C}$

9) $B(C\bar{D}E + \bar{E}FG)(\bar{A}\bar{B}+C)$

$\bar{\bar{B}}$ $\quad \overline{\overline{C\bar{D}E} \cdot \overline{\bar{E}FG}}$ $\quad \overline{\overline{\bar{A}\bar{B}} \cdot \bar{C}}$



Adiacepen Karnauhan lecte

$f_1 = \bar{A}\bar{C} + A\bar{C}D + \bar{A}BC\bar{D}$

$[\cancel{\bar{A}\bar{C}\bar{B}\bar{D} + \ldots}]$

$\bar{A}\bar{C}\bar{B}\bar{D} + \bar{A}\bar{C}\bar{B}D + \bar{A}\bar{C}B\bar{D} + \bar{A}\bar{C}BD + A\bar{B}\bar{C}D + AB\bar{C}D + \bar{A}BC\bar{D}$

0000 1001 0111
0001 1101
0100
0101

$f_2 = \overline{ACD} + AC + ABC$ $\quad (\cancel{\ldots})$

$\overline{ACD}B + \overline{ACD}\bar{B} + AC\bar{B}\bar{D} + AC\bar{B}D + ACB\bar{D} + ACBD + ABCD + ABC\bar{D}$

$\overline{ACD}B + \overline{ACD}\bar{B} + A\bar{B}C\bar{D} + A\bar{B}CD + ABC\bar{D} + ABCD$

$f_3 = \bar{A}B + AC$

$\bar{A}BCD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}B\bar{C}\bar{D} + ACBD + AC\bar{B}D + ACB\bar{D} + AC\bar{B}\bar{D}$

$f_4 = (A+\bar{B}+C+\bar{D})(\bar{A}+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+\bar{D})(\bar{A}+\bar{B}+\bar{C}+\bar{D})$ 0101 | 1101 | 0111 | 1111
$(A+\bar{B}+C+D)(A+\bar{B}+\bar{C}+D)(A+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+\bar{D})$ 0100 | 0110 | ~~0101~~ | ~~0111~~
$(A+B+C+\bar{D})(\bar{A}+B+C+\bar{D})(A+\bar{B}+C+\bar{D})(\bar{A}+\bar{B}+C+\bar{D})$ 0001 | 1001 | ~~0101~~ | 1101
$(A+B+C+\bar{D})(A+\bar{B}+C+\bar{D})(A+B+\bar{C}+\bar{D})(A+\bar{B}+\bar{C}+\bar{D})$ ~~0001~~ | ~~0101~~ | 0011 | ~~0111~~

$(A+\bar{B}+C+\bar{D})(\bar{A}+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+\bar{D})(\bar{A}+\bar{B}+\bar{C}+\bar{D})(A+\bar{B}+C+D)(A+\bar{B}+\bar{C}+D)$
$(A+B+C+\bar{D})(\bar{A}+B+C+\bar{D})(\bar{A}+\bar{B}+C+\bar{D})(A+B+\bar{C}+\bar{D})$

ED-II-A: ketak-012

$$f_5 = (x_1+x_3+x_2+x_4)(x_1+x_3+\bar{x}_2 x_4)(x_1 x_3 x_2 x_4)(x_1 x_3 \bar{x}_2 \bar{x}_4)$$

$$(x_3+x_2x_4+x_1)(x_3+x_2x_4+\bar{x}_1)$$

0 ∧ B ∧ ∧

$\boxed{\text{KARNAUGH}}$

2.1 $F = \bar{a}\cdot b + \bar{a}\cdot\bar{b} + a\cdot\bar{b}$

01 00 10

A \ B	0	1
0	1	1
1	1	

$\bar{A} + \bar{B}$

2.2 $F = (\bar{a}+\bar{b})(\bar{a}+b)\cdot(a+b)$

11 10 00

A \ B	0	1
0	0	
1	0	0

$\bar{A}\cdot B$

2.3 $F = a\cdot b\cdot c + \bar{a}\cdot\bar{b}\cdot\bar{c} + a\cdot b\cdot\bar{c} + a\cdot\bar{b}\cdot c$

111 000 110 101

AB \ C	0	1
00	1	
01		
11	1	1
10		1

$\bar{A}\bar{B}\bar{C} + AB + AC$

2.4 $F = (a+b+c)\cdot(\bar{a}+b+c)\cdot(a+\bar{b}+\bar{c})\cdot(\bar{a}+\bar{b}+\bar{c})$

000 100 011 111

C \ AB	00	01	11	10
0	0			0
1		0	0	

2.5 $F = a\cdot b + a\cdot c + a\cdot\bar{b}\cdot\bar{c}$

110 101 100
111 111

C \ AB	00	01	11	10
0			1	1
1			1	1

$\boxed{A}$

2.6 $F = b\cdot(a+\bar{c})\cdot(\bar{a}+b+\bar{c})$

$(ab + b\bar{c})(\bar{a}+b+\bar{c})$

$\cancel{ab\bar{a}} + abb + ab\bar{c} + b\bar{c}\bar{a} + b\bar{c}b + b\bar{c}\bar{c}$

$ab + ab\bar{c} + \bar{a}b\bar{c} + b\bar{c} + \cancel{b\bar{c}}$

~~110~~ ~~110~~ 010 ~~010~~
111 110

C \ AB	00	01	11	10
0		1	1	
1			1	

2.7 F =

C \ AB	00	01	11	10
0	1	0	1	1
1	1	0	0	1

$\bar{B} + A\bar{C}$

$(A+\bar{B})\cdot(\bar{B}+\bar{C})$

ED-II-Ariketak-013

2.10

C \ AB	00	01	11	10
0	0	0	0	0
1	1	0	1	1

min $\bar A\bar B C + ABC + A\bar B C$

max $(A+B+C)(A+\bar B+C)(\bar A+\bar B+C)(\bar A+B+C)(A+\bar B+\bar C)$

2.9 $F = a\cdot b\cdot c + a\cdot \bar b\cdot c + a\cdot b\cdot \bar c + \bar a\cdot \bar b\cdot \bar c + \bar a\cdot b$

111 101 110 000 010 011

AB \ C	0	1
00	1	
01	1	1
11	1	1
10		1

$\bar A\bar C + AC + B$

2.10

minterms $\boxed{B\bar C + AB}$

maxterms ~~[illegible]~~ $\boxed{(A+\bar C)\cdot B}$

2.11

a	b	c	f
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

C \ AB	00	01	11	10
0	1	0	0	1
1	0	0	0	1

$A\bar B + \bar B\bar C$ minterms

$\bar B + (A+\bar C)$ maxterms

2.12

a	b	c	f
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

AB \ C	0	1
00		
01	0	0
11		
10		

$\boxed{A+\bar B}$

2.13

a	b	c	f
0	0	0	x
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	x

C \ AB	00	01	11	10
0	x	0	0	0
1	1	1	x	1

C ~~[illegible]~~ minterms

C · ~~[illegible]~~ maxterms

Kasu bietan emaitza → C

! Balio zehaztugabeak ez dira beharrean erabiltzen?

Ondo badatorkigu, erabiliko ditugu, bestela ez

ED - II - Ariketak - 014

2.14

a	b	c	f
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	x
1	0	0	0
1	0	1	1
1	1	0	x
1	1	1	1

AB \ C	0	1
00	1	1
01	0	X
11	X	1
10	0	1

maxterms

$(A+\bar{B})(\bar{A}+C)$

minterms

$\bar{A}\bar{B}+C$

2.15

$F = \bar{a}\cdot\bar{b}\cdot\bar{c}\cdot\bar{d} + \bar{a}\cdot\bar{b}\,c\,d + \bar{a}\cdot\bar{b}\,c\cdot\bar{d} + \bar{a}\cdot b\cdot\bar{c}\cdot d + ab\bar{c}d + abc\bar{d} + a\bar{b}\bar{c}d$

0000   0011   0010   0101   1101   1110   1001

AB \ CD	00	01	11	10
00	1		1	1
01		1		
11		1		1
10		1		

$A\bar{C}D + B\bar{C}D + \bar{A}\bar{B}\bar{D} + \bar{A}\bar{B}C + ABC\bar{D}$

2.16

$F = (a+b+c+\bar{d})\cdot(a+b+c+d)(\bar{a}+\bar{b}+\bar{c}+\bar{d})(a+\bar{b}+c+\bar{d})(a+b+\bar{c}+d)$

0001   0000   1111   0101   0010

AB \ CD	00	01	11	10
00	0	0		0
01		0		
11			0	
10				

2.17 $F = a\bar{d} + b\cdot\bar{d}$

1000   0100
1010   0110
1100   ~~1100~~
1110   ~~1110~~

AB \ CD	00	01	10	11
00				
01	1		1	
10	1		1	
11	1		1	

2.18

$F = (a+c)(a+\bar{b})(\bar{a}+b+\bar{d})$

0000   ~~0100~~   1001
0001   ~~0101~~   1011
0100   0110
0101   0111

CD \ AB	00	01	11	10
00	0	0		
01	0	0		0
11		0		0
10		0		

2.19 $F = \bar{a}\cdot\bar{b}\cdot\bar{c}\cdot\bar{d} + a\cdot\bar{b}\cdot\bar{c}\cdot\bar{d} + \bar{a}\cdot\bar{b}\cdot\bar{c}\cdot d + \bar{a}\cdot b\cdot\bar{c}\cdot d + ab\bar{c}d + \bar{a}\bar{b}cd + \bar{a}\bar{b}c\bar{d} + a\bar{b}c\bar{d}$

0000 1000 0001 0101 1101 0011 0010 1010

CD \ AB	00	01	11	10
00	1			1
01	1	1	1	
11	1			
10	1			1

$\bar{A}\bar{B} + B\bar{C}D + \bar{B}\bar{D}$

! Lau eskinetan daudenek, talde bat osatu dezakete

2.20

0000
0001
0011
0010
0100
0101
0111
0110
1111

CD \ AB	00	01	11	10
00	0	0		
01	0	0		
11	0	0	0	
10	0	0		

$\boxed{A\cdot(\bar{B}+\bar{C}+\bar{D})}$

2.21

0000
0100
1000
1100
1010
1011
1110
1111
0001
0011
0010

CD \ AB	00	01	11	10
00	1	1	1	1
01	1			
11	1		1	1
10	1		1	1

$\boxed{\bar{A}\bar{B} + \bar{C}\bar{D} + AC}$

2.22

1100
1110
0000
0010
1000
1010

CD \ AB	00	01	11	10
00	0		0	0
01				
11				
10	0		0	0

$\boxed{(\bar{A}+D)(B+D)}$

2.23

CD \ AB	00	01	11	10
00	0	1	0	0
01	0	1	0	0
11	1	1	1	1
10	1	0	1	1

maxterms $(\bar{A}+C)(B+C)(A+\bar{B}+\bar{C}+D)$

minterms $CD + AC + \bar{A}B\bar{C} + \bar{B}C$

ED - II - Ariketak - 016

2.24

CD \ AB	00	01	11	10
00		1	1	1
01	1	1	X	X
11				
10		X		

$\boxed{B\bar{C} + \bar{C}D}$

2.25

CD \ AB	00	01	11	10
00	1	1	0	X
01	1	0	0	0
11	1	X	0	X
10	1	1	0	1

$(\bar{A}+\bar{B})(\bar{B}+\bar{D})(\bar{A}+\bar{D})$

$\bar{A}\bar{B} + \bar{A}\bar{D} + \bar{A}\bar{C} + \bar{B}C$

2.26

01111
00011
01100
01000
11000
00001
10001
11111
10011
10110

DE \ ABC	000	001	011	010	110	111	101	100
00			1	1	1			
01	1							1
11	1		1			1		1
10							1	

2.27

00000 0
00001 1
00010 2
00011 3
00100 4
00101 5
00110 6
00111 7
~~00001 1~~
~~00101~~
01001 9
01101 12
10001 17
10101 21
11001 25
11101 29
01011 11
01111 15
11011 27
11111 31
10000 16
~~10001~~
10010 18
10011 19
10100 20
~~10101 21~~
10110 22
10111 23

CD \ AB	00	01	11	10
00	1			1
01	1			1
11				1
10	1			1
00	1		1	1
01	1	1	1	1
11	1	1	1	1
10	1	1	1	1

E=0

E=1

$AE + A\bar{B}E + A\bar{B} + \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}\bar{D}$

$AE\,(\cancel{1+\bar{B}}) + A\bar{B} + \bar{A}\bar{B}(\bar{C}+\bar{D})$

$A\,[E + \bar{B}$

$\bar{B}\,[A + \bar{A}(\bar{C}+\bar{D})] + AE$

CD \ AB	00	01	11	10
00				
01				
11				
10				

E=0

CD \ AB	00	01	11	10
00				
01				
11				
10				

E=1

ED - II - [illegible] - 017

2.28

E=0

CD \ AB	00	01	11	10
00	1			1
01	1			1
11		1	[illegible]	
10	1	1	1	1

E=1

CD \ AB	00	01	11	10
00				
01				1
11		0	1	
10	1	1	1	1

5 katlı

~~$C\bar{D} + \bar{A}\bar{B}C + A\bar{B}C\bar{D} + \bar{B}C\bar{D} + \bar{B}C\bar{E}$~~

$C\bar{D} + ABC\bar{E} + A\bar{B}\bar{C}D + \bar{B}\bar{C}\bar{E} + \bar{A}BC\bar{E}$

[illegible]

a) (+5) + (+2) = (+7)

0101 → 1010 → 1011
0010 → 1101 → 1110
0111 → 1000 → 1000

$\boxed{0111}$ → 0110 → 1001

0101
0010
0111

b) (−5) + (+2) = (−3)

0101 → 1010 → 1011
0010 → 1101 → 1110
0011 → 1100 → 1100

1011
10010
1101 → 1100 → $\boxed{0011}$

1011
0010
1101 → 1100 → 0011

c) (+5) + (−2) = (+3)

0101 → normal
1110 → 2ks

$\boxed{0011}$ → 0010 → 1101

0101
1110
0011 → 0010 → 1001

[illegible]

d) (−5) + (−2) = (−7)

1011 → 2ks
1110 → 2ks

~~[illegible]~~
11001 → 1000 → $\boxed{00111}$

1011
1110
1001 → 1000 → 0111

[illegible]

101 → 010 → 011
010 → 101 → 110
1001 → 1000 → 0111

e) (+5) − (+2) = (+3)

0101 → normal
1110 → 2ks

$\boxed{0011}$ → 0010 → 1101

ED-II-Aritmetik-[illegible]

f) (-5) - (+2) = (-7)

0101 → 1010 → 1011
0010 → 1101 → 1110

1011 → bk
1110 → bk

0001 → 0000 → 1111 →

g) (+5) - (-2) = (+7)

0101 normal
0010 normal

$\boxed{0111}$

h) (-5) - (-2) = (-3)

1011 bk
0010 normal

1101 → 1100 → $\boxed{0011}$

i) (+7) + (+2) = +9

0111 → 1000 → 1001
0010 → 1101 → 1110

~~1001~~
~~1110~~
~~10111~~

0111
0010
$\boxed{1001}$

j) (-7) + (+2) = (-5)

1001
0010

1011 → 1010 → $\boxed{0101}$

k) (+7) + (-2) = (+5)

0111
1110
1$\boxed{0101}$ → 10100 → 01011

0111 → 1000 → 1001
0010 → 1101 → 1110

0111
1110
10101

l) (-7) + (-2) = (-9)

1001
1110

10111 → 10110 → $\boxed{01001}$